実験水槽を用いた海氷の厚さとマイクロ波輝度温度の関係

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Relationship between thickness of thin sea ice and microwave brightness temperature derived from a sea ice tank experiment

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The brightness temperature measured by a satellite microwave radiometer represents an integral average of microwave emissions from a relatively large footprint. Thus, it is difficult to examine the relationship of sea ice thickness with the measured brightness temperature since the observed area may consist of many different types of ice with different thicknesses. There are few reports that observe the relationship between uniform thickness of sea ice and luminance temperature in detail(e.g. Grenfell and Comiso, 1986; Shokr *et al.*, 2009). Therefore, to study how the microwave brightness temperature changes with sea ice thickness, we performed a sea ice tank experiment in Kushiro City of Hokkaido, Japan. The tank has a diameter of 3meters and was filled with Pacific Ocean sea water with salinity of 33 ppt to a depth of 0.9 meters. The tank was installed outdoors and covered with a hood to keep the surface from being covered by snow. The brightness temperature of the surface sea ice layer was measured at regular intervals as the sea ice thickness increases under subfreezing temperatures. The microwave brightness temperture measurements were made at 18 GHz and 36 GHz for both vertical(V) and horizontal(H) polarizations using a portable microwave radiometer. The incident angle of the radiometer was set to 55 degree to be consistent with that of the AMSR2 microwave radiometer on board the GCOM-W1 satellite. During the experiment, the sea ice thickness went up to 11 cm. The observed brightness temperature was lowest for the open water surface and increased as sea ice grew thicker(Fig.1). The brightness temperature at 36 GHz reached a maximum value of 258K for V and 215K for H when the ice thickness reached about 2 cm and became nearly constant after that.　The brightness temperature at 18 GHz reached a maximum value of 255K for V and 208K for H at about 4 cm thickness and became constant as the ice thickness increased further. The results suggest the limitation of measuring sea ice thickness using microwave radiometers at frequencies of 18 GHz and 37 GHz and that the use of lower frequency channels would likely provide more useful thickness information.

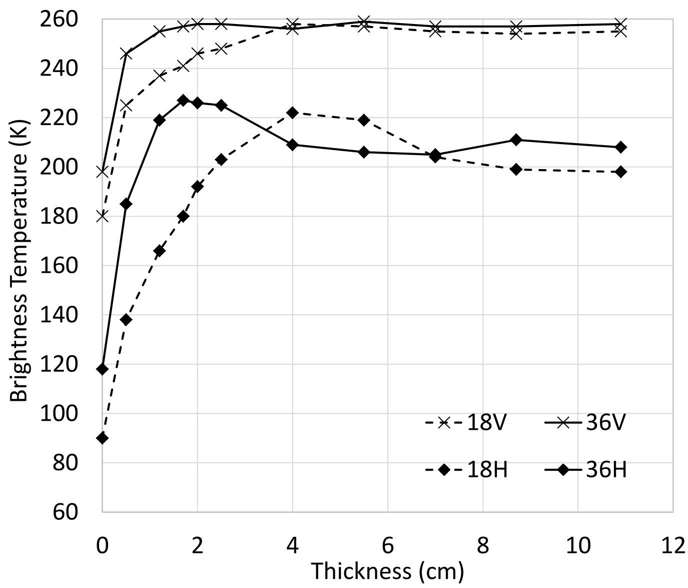

Figure 1. Relationship between sea ice thickness and brightness temperature

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